

Bond Type Curves

*A Quantifiable and Transparent Approach to
Municipal Bond Price Discovery*



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BondWave Advisors™ is a division of BondWave LLC that serves as a consultant and advisor to registered investment advisors during development and ongoing management of investment strategies and Program Portfolios methodology.

BondWave LLC
120 E. Liberty Drive, Suite 400
Wheaton, Illinois 60187
877.795.6288
www.BondWave.com

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Introduction

BondWave's methodology incorporates a concept called "**Bond Types**" that combines one or more bond attributes (such as rating, maturity, duration and more) to describe or identify "similar" sets of bonds. Bond Types provide a flexible and powerful tool for portfolio modeling and yield curve analysis. When Bond Types are used in conjunction with trade data, the resulting "**Bond Type Curves**" provide a quantifiable and transparent approach to municipal bond price discovery.

This paper reviews how current municipal bond pricing benchmarks fall short of full transparency and how Bond Type Curves provide a transparent and objective assessment of market prices based on factual data, not subjective methodologies.

Current Municipal Benchmarks Lack Full Transparency

Due to the extremely fragmented nature of the municipal bond market, there is no easily identified benchmark from which to derive price and yield information (in contrast to many other debt securities markets). While most fixed income markets are referred to as “spread products”, the question for the municipal market is: “Spread to What?”. The unique characteristics of the municipal market make it virtually impossible to find a bellwether issuer - or even one which trades - with consistency. While there are well over ten thousand individual transactions every day, there are relatively few in any one security or issuer. Thus, market participants have been forced to seek alternatives for benchmarking purposes.

These alternatives have generally fallen into two categories:

- **Synthetic yield curves** based on opinions of analysts or market participants.
- **Indices** such as general obligation and revenue indices.

The development of these tools has generally provided market participants with common benchmark information upon which price discovery is based. However, the methodology employed as well as the data inputs into any of these models, are generally not transparent. This leads to questions concerning their overall usefulness and accuracy.

Trade Reporting Makes an Attempt at Transparency

The Municipal Securities Rulemaking Board (MSRB) and the Securities and Exchange Commission (SEC) recognized the glaring need for greater transparency in the municipal market. In 2001, regulations were instituted that mandated trade reporting of municipal transactions. With the advent of trade reporting, municipal market participants were able to track security and price information for the first time. Initially, reports were available a day following the trade date, but transparency made a great leap forward with the introduction of near real-time reporting on a fifteen-minute delay in 2005. For the first time, this step truly provided participants with contemporaneous trade price discovery in a meaningful, actionable way.

Yet, even with these significant strides towards transparency, the fragmented quality of trade data for any particular security presented a conundrum for many participants. How could they glean meaningful information from the vast amount of trade data? How could one make a meaningful comparison of a given security to the securities represented in the MSRB trades?

The Ideal Solution

If one were to ask virtually any market professional the question: “How does price discovery occur in the municipal market?”, the overwhelming answer would likely be: “Through a ‘relative value’ analysis.” By this response, most would mean a comparative process that takes a security of interest, seeks to find similar securities of a known price, and then applies an analysis of how these are similar and different to arrive at a valuation.

Much like someone seeking to assess the value of a home for sale versus comparable homes, there is rarely an exact comparison to be made. However, there are generally a number of other homes that have sold in the area and with which a comparison can be made. The challenge is to analyze how these homes are different and how to value the differences. In the same way, municipal market participants seek to find securities which are “similar” and to compare the differences in an effort to arrive at a price determination. If one can find these kinds of comparisons, then a reasonable assurance can be reached as to the proper valuation of a security.

Logically, the ideal solution would provide market participants with an efficient way to compare securities along meaningful, quantifiable and objective characteristics. If participants could gather enough data to create a “meaningful fact pattern”, they could achieve a high degree of assurance that their analysis was valid. Likewise, if one were able to represent trade data for each point on the yield curve, one would have a similarly high degree of assurance that the information contained in that curve was objective, accurate and useful. Thus, the challenge is: “How can such a tool be created?”

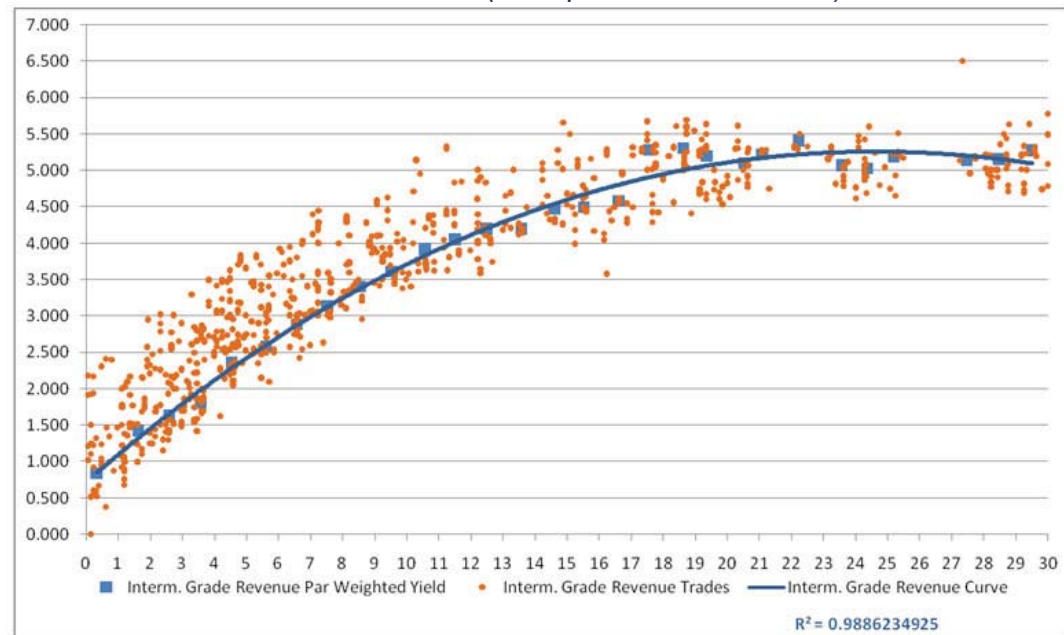
Bond Type Curves Provide Quantifiable and Transparent Price Discovery

What market participants should value above all in price discovery is contemporaneous price data: **actual trades where money is changing hands**. Opinions lead to trades, but the trade itself is the truest measure of market price.

As we recognize, there exists a rich set of data available for the support of price discovery: **MSRB transaction data**. We also postulate that gaining the ability to further apply comparative security attributes to the MSRB trade data would, for the first time, enable market participants to combine sufficient information with the “relative value process”, thus enabling a meaningful empirical analysis in the price discovery process.

BondWave Advisors has introduced empirically-derived yield curves called **Bond Type Curves** that are based on a completely transparent, objective, fact-based methodology. Market participants are given full access to information on how the curves are designed, what inputs are analyzed, and how the inputs are defined. Consequently, participants now have a means to analyze the transparency provided in MSRB trade data.

Intermediate Grade Revenue Curve (example as of 04/09/2009)



More About Bond Types: The DNA of Fixed Income Securities

Municipal securities have many descriptive characteristics and attributes, which include:

- Simple descriptive elements, such as coupon and maturity;
- Quality indicators, such as rating;
- Elements related to the source of payment for an issue;
- Usage of the bond proceeds – and more.

BondWave Advisors' proprietary approach evaluates over 80 attributes for each municipal security. One or more of these attributes are combined in an individual Bond Type that may be used to describe or identify "similar" sets of bonds. Bond Types are the building blocks used to create Bond Type Curves (much like a DNA molecule identifies the genetic structure of the larger organism). As a result, Bond Type Curves provide a rich fabric of information upon which we can compare and contrast individual securities. In essence, we attempt to quantify the "relative value" process and greatly expand the observable fact-set upon which analysis can be based.

We believe Bond Type Curves allow us to achieve a very high degree of analytic detail and provide the ability to derive a much greater amount of useful information from the MSRB trade data. Ultimately, this process provides a more transparent and objective assessment of market prices based on factual data, not subjective methodologies.

Bond Type Curves - Design and Methodology

BondWave Advisors designed Bond Type Curves to represent meaningful subsets of the municipal market. Each curve is defined by a combination of quality rating, source of payment, purpose of proceeds, state income tax treatment and tax rate, whether “bank qualified” or not, plus specific curves for California bonds. All curves are designed to provide comparative value. The following Bond Type Curves are currently available:

- High Grade General Obligation
- High Grade Revenue
- High Grade Bank Qualified
- High Grade High States Tax
- High Grade Intermediate States Tax
- High Grade Low Tax States
- High Grade No Tax Advantage States
- California General Obligation
- California Revenue
- Intermediate Grade General Obligation
- Intermediate Revenue
- Intermediate Grade Bank Qualified
- Lower Investment Grade General Obligation
- Lower Investment Grade Revenue

Calculation Methodology

Each Bond Type Curve is created with a consistent design and calculation methodology that enables meaningful comparison to each other and over time. That methodology includes the following steps:

1. The Bond Types that comprise each individual curve are defined. The curves are grouped into general categories: quality grades, source of payment, state interest taxation, bank qualification, and specific indices for California bonds.
2. We identify trades that match the specific Bond Type attributes associated with each curve. MSRB trade records include a field that indicates whether the trade was dealer-to-dealer, sale-to-customer, or purchase-from-customer. We use all three types of transactions in our calculation. We exclude trades for securities with zero coupons as they represent a fundamentally different type of debt investment than bonds which pay interest over the life of the security.
3. We then group the trades by “years to effective maturity”, which is either the stated maturity or the date of an announced redemption.
4. We then employ a par weighting formula for both the yield and the effective maturity. From this we produce a scatter plot graph and then calculate a “best fit curve”*. We then add all trades to the original scatter plot graph. For each trade we calculate the deviation from the “best fit curve”. For those trades that are greater than +/- 2.58 standard deviations (a factor that our analysis shows to be statistically valid) we exclude from consideration as outliers.
5. With the remaining trades we recalculate the “best fit curve” following the same methodology employed with the original group of trades described in step two. This results in a curve derived from par weighted trade data using commonly accepted statistical methodology.

As a final step we identify the trade “metrics” that went into calculation of each curve- the number of trades, par value traded, and the “R-squared” value** for the best fit curve.

* Best Fit Curve- we employ a third order polynomial equation to determine a graphical curve that represents the individual data points of a scatter plot graph accurately.

** R-squared value- also known as the “coefficient of determination”, is a statistic which indicates the strength of fit between two variables implied by a particular value of the sample correlation coefficient r . The highest possible value would be “1”, indicating a perfect positive correlation.

Taken as a whole, we believe that the transparent methodology, visual display of the raw data and the calculated results provide a highly meaningful level of information and context that allows a user unprecedented insight into actual yield and price levels as determined by contemporaneous trades.

Bond Type Design and Definition

Quality Grades

We first calculate a composite rating from a security's Moody's and Standard & Poor's rating. Our composite weighting process uses the higher rating value of either Moody's or Standard and Poor's if there is a discrepancy. If a bond carries insurance or another type of credit enhancement, there is an additional test for the underlying rating. We group securities into the following categories based on their ratings:

- **High Grade** (AAA and AA+ rated bonds) are securities that have a rating of at least AA+, even if the stated rating is lower due to an enhancer downgrade. Likewise, we apply a minimum underlying rating test of at least composite A+ for enhanced bonds.
- **Intermediate Grade** (AA, AA- and A+ rated bonds) are securities that have ratings between AA and A+. We apply a minimum underlying rating test of at least A- for enhanced bonds.
- **Lower Investment Grade** (A, A-, and BBB+ rated bonds) are securities that have ratings between A and BBB+. We apply a minimum underlying rating test of BBB- for enhanced bonds.

Source of Payment

The source of funds available to pay interest and principal on a security is an important consideration in determining the creditworthiness of a bond. The universe of municipal securities is characterized by two primary sources of payment - General Obligations and Revenues:

- **General Obligation Bonds** are simply defined as bonds with a general obligation pledge, whether that is unlimited or limited as to property taxation, full faith and credit pledge, or the bond is "double-barreled" (in which case the bond is generally paid through revenues but also carries a general obligation pledge).
- **Revenue Bonds** are defined as bonds paid by defined sources other than a general obligation pledge. These sources may be from leases or rentals, sales or excise taxes, utility charges or fees. We have chosen not to include

revenue types that are generally considered more volatile, such as hospital and housing revenue bonds.

Use of Proceeds

Each municipal bond is issued for a specific purpose - which we refer to as “use of proceeds”. Our methodology employs over seventy types of specific proceed uses for municipal issues. Examples include airports, electric and public power, higher education and sewer to name a few. Because our focus is on higher quality bonds, we generally limit the “use of proceeds” types to those that would qualify as general purpose and utility uses.

The Sources of Payment and Use of Proceeds parameters allow us to precisely define the types of securities that we utilize for calculation of Bond Type Curves. Thus, a consistent framework is applied within the quality grades.

State Tax Categories

Many states do not require investors to pay state income tax on interest income from municipal securities issued within that state. Depending on an investor’s marginal state income tax rate, this can be a strong incentive for an investor to buy securities from “in-state” issuers. This preference can have a significant effect on the interest rates that issuers pay- in effect - subsidizing their cost of interest.

We have analyzed both the income tax rates for each state and the tax treatment of interest and formulated a four-tier model of the state tax impact on municipal securities. The four categories are:

- **High Tax Rate Group** -The states included in this group have a minimum income tax rate of 7.75%, treat in-state bond interest as exempt and tax out-of- state bond interest. We exclude California from this group as we treat it uniquely through its own curves.
- **Intermediate Tax Rate Group** - The states included in this group have a minimum income tax rate of 5.50%, treat in-state bond interest as exempt and tax out-of-state bond interest. However, we have included the state of Arizona in this group for the sole reason that the high proportion of retirees who provide demand for municipal bonds cause those securities to trade at an exaggerated

price level relative to the tax benefit afforded.

- **Low Tax Rate Group** - The states included in this group have a minimum income tax rate of 3.00%, treat in-state bond interest as exempt and tax out-of-state bond interest.
- **No Inherent Tax Benefit Group** - The states in this group treat municipal bond interest in such a way that there is not a preference for holding in-state bonds over out-of-state bonds. In some cases neither are taxed; in some cases both are taxed.

Bank Qualification

In 1986 a new category of municipal securities was created: “bank qualified” bonds. Bond issues that meet certain criteria allow a bank to deduct interest costs associated with their purchase. Because of this special designation these issues tend to trade differently than those issues not so qualified. We designed two bank qualified curves: one for each of the two highest quality grades defined previously. These do not follow the general obligation/ revenue framework, but are instead designed to represent a single basket of issues available to banks. These curves exclude those types of proceed uses which are likely to fall under a private purpose categorization, such as hospital and housing issues. We also excluded any bonds secured by tobacco settlement payments, due to their unique source of payment and resulting lack of correlation.

California Issues

As the most populous state in the country and with a high tax rate on interest income from out of state municipal bonds, California issues trade differently than other states. We constructed two California-only curves and excluded California bonds from any other state tax curves to reflect their unique status.

These curves follow the general obligation and revenue framework discussed previously. The quality ratings chosen are for securities with a AA- or higher rating and an underlying rating of at least BBB+.

Bond Type Curve Attribute Summary

	High Grade	Intermediate Grade	Lower Investment Grade	General Obligation	Revenue	Composite Revenue & G.O.	High Tax Rate	Medium Tax Rate	Low Tax Rate	No Tax Benefit	Bank Qualified	California
High Grade General Obligation	●			●								
High Grade Revenue	●				●							
High Grade Bank Qualified	●					●					●	
High Grade High Tax	●					●	●					
High Grade Medium Tax	●					●		●				
High Grade Low Tax	●					●			●			
High Grade No Tax Benefit	●					●				●		
California General Obligation				●								●
California Revenue					●							●
Intermediate Grade General Obligation		●		●								
Intermediate Grade Revenue		●			●							
Intermediate Grade Bank Qualified		●				●					●	
Lower Investment Grade General Obligation			●	●								
Lower Investment Grade Revenue			●		●							

Using Bond Type Curves

As we stated previously, municipal market participants suffer from the lack of a benchmark with which to make trade comparisons. BondWave Advisors' goal with the development of Bond Type Curves is to provide a transparent, objective set of specific reference curves. Bond Type Curves can be used to track changes in municipal rates over time, to analyze the shape of the yield curve, to compare to other fixed income market rates or to compare to each other. With their clearly-defined methodology, each curve can also serve as an effective means to make a comparison of a specific security.

We also display pertinent information - the individual trades and metrics - on how each curve was calculated to add important context the curve itself. Taken as a whole, we believe Bond Type Curves provide participants with a wealth of information to support price discovery in the municipal market.

Summary

With the introduction of Bond Type Curves, BondWave Advisors seeks to fundamentally change the way municipal market participants understand and utilize yield curve information. For the first time, participants can use an empirically-derived, transparently-constructed yield curve with defined inputs and a consistent methodology. The concept of “relative value” has at last been translated into a quantifiable product.

We strongly believe that transparency - in its objective nature - is inherently superior to opinion. We adhere completely to the view that contemporaneous trade data represents the truest measure of prices and yields in the municipal market. When combined with BondWave Advisors’ proprietary tools in the construction of Bond Type Curves, the result is vibrant, meaningful information which enables price and yield discovery.